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 [EP1125958 A1 20010822 \[EP1125958\]](#)**(A1) Process for the preparation of hydrophilic flame-retardant polyurethane soft foams**

(A1) Verfahren zur Herstellung von hydrophilen flammgeschützten Polyurethanweichschaumstoffen

(A1) Procédé de préparation de mousse de polyuréthane souples, hydrophiles et ignifugeantes

Hydrophilic flame retardant flexible polyurethane foam is prepared by reaction of a polyetherol mixture comprising one 2-8 functional polyetherol, based on propylene oxide and/or butylene oxide and ethylene oxide and at least one polyetherol based on propylene oxide and/or butylene oxide and the flame retardant is melamine, optionally in combination with other flame retardants. <??>Hydrophilic flame retardant flexible polyurethane foam (I) is produced by reaction of an optionally modified organic polyisocyanate with (B) a polyetherol mixture and optionally (C) other compounds having isocyanate reactive hydrogen atoms in the presence of (D) water and/or other propellants, (E) catalysts, (F) flame retardants and optionally (H) other additives and processing aids. The polyetherol mixture (B) comprises one 2-8 functional polyetherol, based on propylene oxide and/or butylene oxide and ethylene oxide, whereby the oxide content (with respect to total alkylene oxide content) is greater than 40 wt.-%, having an OH number of 2 mgKOH/g and a prim. OH group content of greater than 50 % whereby (B11) contains at least one difunctional polyetherol (B1.1) having an OH number of 20-100 mg KOH/g and (B2) at least one polyetherol based on propylene oxide and butylene oxide having an OH number of greater than 30 mg KOH/g and the flame retardant (G) is melamine, optionally in combination with other flame retardants.

Designated States : AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
AL LT LV MK RO SI**Application Nbr :** EP01103202 20010212 [2001EP-0103202]**Priority Details :** DE10007693 20000219 [2000DE-1007693]**Inventor(s) :** (A1) FALKE PETER DR (DE); HENDREICH REGINA (DE); JACKSON GARY (GB)**Patent Assignee :** (A1) BASF AG (DE)

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NIAX® Processing Additive DP-1022

Crompton
OSI Specialties

■ Product Description

Niax® processing additive DP-1022 is a reactive polyfunctional additive that finds utility in a number of urethane foam applications. In conventional slabstock foam, Niax processing additive DP-1022 stabilizes the foam bun in critical low-medium density formulations where splits and cracks can occur. Furthermore, it provides the processability necessary to produce soft foams using low isocyanate index, thereby reducing or eliminating the need for auxiliary blowing agents. It also can be used in high resiliency technologies (HR) as well as specialty formulations such as viscoelastic foams.

■ Typical Physical Properties

Appearance	Clear and substantially free of foreign matter
Color, Pt-Co	50 max.
Purity, wt %	98.0 min.
Water, wt %	0.05 max.
Flash Point, PMCC, °F	>230
Hydroxyl Number (mg KOH/g)	1200
Specific Gravity, g/cc @ 25°C	1.02
Viscosity, cps @ 25°C	175

■ Formulation and Use

The use of Niax processing additive DP-1022 in low-medium density formulations can help reduce processing problems often encountered when foaming with methylene chloride or fillers. At 0.5 - 1.5 pts., Niax processing additive DP-1022 provides excellent foam processing and bun stability. Only minor catalyst adjustments are needed. A reduction of stannous octoate by 5-10% is required for optimum processability. This will vary depending on the formulation.

The use of Niax processing additive DP-1022 can partially or totally replace auxiliary blowing agents in soft slabstock foam formulations. At 1-2 pphp, Niax processing additive DP-1022 provides the processability to allow conventional slabstock formulations to be manufactured at 95-100 TDI index. Manufacturing foam at 95 index can reduce the hardness (25% IFD) of the foam by up to 50% from that made at 110 index. At 95-100 index, the foam physical properties are similar to more conventional index foams. In the 105-110 index range, Niax processing additive DP-1022 does not alter foam processability and can improve certain foam characteristics.

OSI Specialties history spans 40 years of urethane additives leadership. In the 1950's, we invented the silicones that enabled the urethane foam industry to adopt the more efficient "one-shot" foaming process. Today, we offer a full portfolio of performance-driven Niax® catalysts, Niax® silicones and Geolite® modifiers that enhance performance properties.

OSI Specialties has set the pace – and the standard – in the polyurethane foam industry, earning a global reputation for technical innovations and support. All of these breakthroughs were developed as answers to our customers' processing problems, physical property deficiencies, and environmental concerns.

Sales representatives in nearly 100 countries worldwide are supported by major plants and technical centers in the United States, Europe, Asia and Latin America. All our major manufacturing facilities have ISO 9002 registrations.

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■ Formulation and Use (continued)

Niax Processing Additive DP-1022 To Eliminate Auxiliary Blowing Agents

Table 1 Soft Foam Additive – TDI Index Levels			
3000 MW Polyol	100	100	100
Niax Processing Additive DP-1022	1.5	1.0	1.0
Water	4.0	4.0	4.0
Niax silicone L-620	0.9	0.8	0.8
Niax catalyst A-230	0.15	0.15	0.15
Stannous Octoate	0.17	0.25	0.17
TDI Index	95	100	105
Density,pcf	1.55	1.58	1.57
IFD, 25%, lbs.	22	28	34

Table 2 Soft Foam Additive – Foam Grade 1.2 PCF / 23 IFD		
	Control	Niax Processing Additive DP-1022 Foam
3000 MW Polyol	100	100
Niax Processing Additive DP-1022	0	1.5
Water	4.1	5.0
Methylene Chloride	7.0	0
Niax silicone L-620	1.2	1.2
Niax catalyst A-230	0.15	0.15
Niax Stannous Octoate	0.20	0.20
TDI Index	105	95
Density,pcf	1.10	1.22
IFD, 25%, lbs.	22	22

Table 3 Soft Foam Additive – Foam Grade 1.4 PCF / 28 IFD		
	Control	Niax Processing Additive DP-1022 Foam
3000 MW Polyol	100	100
Niax Processing Additive DP-1022	0	1.0
Water	3.8	4.1
Methylene Chloride	2.7	0
Niax silicone L-620	0.8	0.8
Niax catalyst A-230	0.14	0.14
Stannous Octoate	0.17	0.17
TDI Index	105	100
Density,pcf	1.47	1.42
IFD, 25%, lbs.	28	27

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■ Niax Processing Additive DP-1022 in HR Foams

Niax® processing additive DP-1022 can be used as a partial replacement for DEOA to improve properties and processing in HR foams. This is especially true in HR foams produced from high functionality polyols such as in Bayer's Ultracel® and Hyperlite® foams. Generally for low to medium density foams, about half of the DEOA can be replaced with Niax processing additive DP-1022. For higher density foams (greater than 3.5 PCF) it may be desirable to substitute a higher percentage of DEOA and/or add additional Niax processing additive DP-1022. The example formulations illustrate the utility of Niax processing additive DP-1022 in HR slabstock foam.

Table 4

	Control A	Niax Processing Additive DP-1022 "A"	Control B	Niax Processing Additive DP-1022 "B"
Arcol® U2000	100	100	100	100
Niax® DP-1022	0	1.5	0	1.5
DEOA-LF	2.94	1.47	2.94	0.44
Water (Total)	3.7	3.7	2.3	2.4
Stannous Octoate (50%)	0.25 to 0.35	0.25 to 0.35	0.05 to 0.10	0.05 to 0.10
Fomrez® SUL-4	0.01 to 0.02	0.01 to 0.02	0.03 to 0.04	0.03 to 0.04
Niax amine Blend	0.15	0.15	0.15	0.25
Niax silicone U-2000	1.0	1.0	0.8	0.8
Fire Retardant	4.0	4.0	2.0	2.0
TDI index	85	85	100	95
Density, pcf	1.76	1.74	2.55	2.56
Resiliency, % rebound	36	57	47	59
Tensile, psi	8.51	11.62	11.42	13.39
Elongation, %	128	149	110	156
Tear, lbs/in	0.85	1.09	0.83	1.15
IFD, 25% 65% 25%R	12.0 30.1 9.9	13.2 33.2 10.7	20.7 53.6 17.8	22.7 55.9 18.9
Air Flow, cfm	0.88	1.70	0.54	1.40
Compression Set	90%	30	22	12
Humid Aged	50%	11	12	4
Tokyo Wet Set	72	59	33	16

Note: Arcol is a registered trademark of Bayer.

Niax processing additive DP-1022 has been found to improve overall HR foam properties when it is partially substituted for DEOA. Improved resiliency as well as compression set properties should be noted – it also will help improve the strenuous wet set characteristics of HR foams. In addition, the above HR formulations were more open, with improved tensile, tear and elongation properties.

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■ Niax® Processing Additive DP-1022 in Viscoelastic Foams

Table 5

Components	Grade	2.4pcf/ 12 IFD	3 pcf/ 12 IFD	2.8 pcf/ 15 IFD	3.4 pcf/ 24 IFD	3 pcf/ 30 IFD
Softcel® VE-1000 (OH-94)	70	70	75	65	50	
Arcol® F-3022 (OH-56)	30	30	25	—	—	
Arcol HS-100 (OH-28)	—	—	—	35	50	
Niax® DP-1022 (OH-1200)	2.0	2.0	1.5	1.5	2.0	
Water	2.3	1.8	1.9	1.5	1.8	
Niax catalyst A-33	0.4	0.4	0.4	0.6	0.4	
Niax catalyst A-1	0.01	0.02	0.02	0.02	0.02	
Fomrez® SUL-4	0.08	0.08	0.08	0.07	0.06	
Niax silicone L-620	0.4	0.4	0.4	0.4	0.4	
Flame Retardant	1.0	1.0	1.0	1.0	1.0	
Index	95	95	100	100	100	
80/20 TDI	36.8	32.4	32.6	26.8	30.7	
Rise Time, Sec.	135	138	163	162	n.b.	
Density, pcf	2.39	3.09	2.81	3.4	2.97	
Resilience, %	15	11	11	12	12	
Air Flow, cfm	1.7	0.59	0.54	0.55	0.03	
IFD, 25%	12.8	13.2	13.9	24.3	33.5	
IFD, 65%	28.7	29.9	32.0	56.5	78.7	
25% Return, %	64.2	72.3	68.6	68.7	60.7	
IFD 65/25	1.24	2.27	2.30	2.33	2.35	
Tensile, psi	9.2	8.5	9.1	14.9	17.8	
Elongation, %	208	159	190	176	150.3	
Tear, pli	0.91	0.75	0.79	1.06	1.29	
75% HACS	24.1	—	9.9	11.3	—	
50% Wet Set	10.8	4.8	5.6	3.1	7.0	

Note: Softcel and Arcol are registered trademarks of Bayer.

Niax® processing additive DP-1022 has been found to aid in foam processing in medium-high density viscoelastic formulations – i.e., slow recovery/memory foams. These types of foams have low resilience, shape retention, vibration and sound dampening, and energy and shock absorption properties. Their unusual properties make viscoelastic foams (VE) ideal for diverse applications. Of particular interest are the mattress/pillow markets in which VE foams offer a new approach to comfort. Niax processing additive DP-1022 for VE formulations allows for more production latitude in these low water/under-indexed formulations.

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■ Niax® Processing Additive DP-1022 in Viscoelastic Foams (Continued)

Table 6

Components	Grade	6 pcf/9 IFD	5 pcf/19 IFD	5 pcf/33 IFD
Softcel® VE-1000 (OH-94)	70	80	50	
Arcol® F-3022 (OH-56)	30	20	—	
Arcol HS-100 (OH-28)	—	—	50	
Niax® additive DP-1022 (OH-1200)	2.0	1.25	2.0	
Water	0.9	1.0	1.0	
Niax catalyst A-33	1.2	1.0	1.0	
Niax catalyst A-1	0.03	0.03	0.03	
Fomrez® SUL-4	0.1	0.03	0.03	
Niax silicone L-627	0.5	0.5	0.5	
Niax silicone L-620	0.4	0.04	0.4	
Flame Retardant	2.0	1.0	0.5	
Index	95	100	100	
80/20 TDI	24.1	25.4	23.0	
Rise Time, Sec.	174	165	170	
Density, pcf	6.2	5.1	5.1	
Resilience, %	0	6	11	
Air Flow, cfm	0.1	0.1	0.1	
IFD, 25%	9.2	19.0	33.5	
IFD, 65%	25.5	47.2	81.0	
25% Return, %	73.4	87.0	77.3	
IFD 65/25	2.77	2.48	2.42	
Tensile, psi	7.8	8.0	18.7	
Elongation, %	214	141	180	
Tear, pli	0.6	0.8	1.4	
75% HACS	—	7.6	4.9	
50% Wet Set	2.9	12.9	8.7	

Note: Softcel and Arcol are registered trademarks of Bayer.

The use of Niax® processing additive DP-1022 in viscoelastic foams at levels of 1-3 pphp helps processing and resultant foam properties. It also helps in dampening and overall strength properties of medium to high density viscoelastic foams. It should be noted in the high density range (5-6 pcf) that a combination of silicone surfactants is used for overall processing (L-627/L-620). The VE formulations listed above utilized T-80 isocyanate – combinations of T-80/T-65 isocyanates can also be formulated to control foam porosity and overall processability.

NIAX® Processing Additive DP-1022

■ Product Safety and Handling

When considering the use of Niax® processing additive DP-1022 you should review the latest Material Safety Data Sheet (MSDS). Precautions should be taken to avoid exposure to the eye or prolonged contact with the skin. If eye contact occurs, flush with plenty of water. If skin contact occurs, wash exposed areas thoroughly with soap and water.

When considering the use of any OSi Specialties products in a particular application, review our latest Material Safety Data Sheets and ensure that the use intended can be accomplished safely. For Material Safety Data Sheets and other product safety information, contact the OSi Specialties sales office nearest you. Before handling any of the products mentioned in the text, please obtain available product safety information and take necessary steps to ensure safety of use.